PRA QUALITY IN REGULATORY DECISIONS

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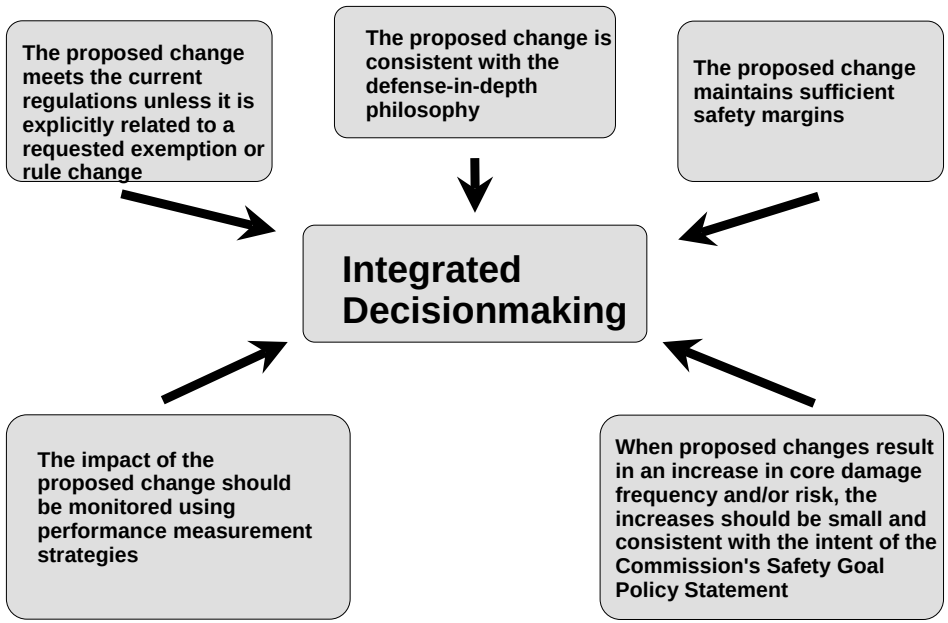
OUTLINE

- Use of PRA results in regulatory applications
- Quality of PRA input to decision-making
- Development and use of PRA Standards and industry peer review program (NEI-00-02)
- Phased approach to achieving PRA quality

USE OF PRA RESULTS IN REGULATORY APPLICATIONS

- NRC has adopted a risk-informed approach to use of PRA in regulatory decision-making
- The philosophy is discussed, in the context of changes to the licensing basis, in RG 1.174
- PRA analyses are one, but not the only, input to the decision

Principles of Risk-Informed Decisionmaking



DEFENSE IN DEPTH

- Reasonable balance of
  - prevention of core damage
  - prevention of containment failure
  - consequence mitigation
- Avoid over-reliance in programmatic activities
- Preserve system redundancy, independence and diversity commensurate with expected frequency
- Independence of barriers is not degraded (e.g., reactor coolant piping and containment)
- Preserve defense against human errors
- Intent of General Design Criteria are maintained

SAFETY MARGINS

- Safety Margins are maintained by ensuring
  - Codes and Standards or approved alternatives are met
  - Safety analysis acceptance criteria in licensing basis are met, or proposed revisions provide sufficient margin to account for uncertainty in data and analysis

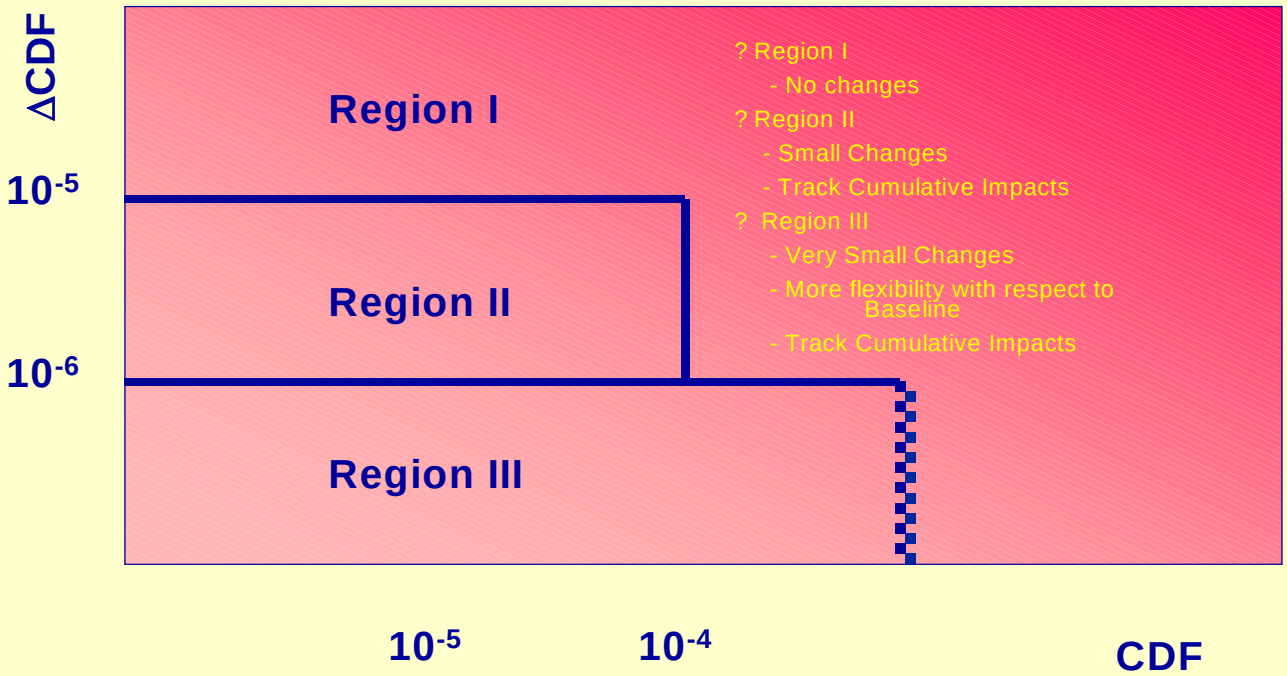
FORMULATION OF PRA INPUT TO APPLICATION

- Identify SSCs, operator actions, and plant operational characteristics affected by application
- Describe impact of proposed application on SSCs, etc. (cause-effect relationship)
- Map impact onto elements of the PRA model

FORMULATION OF PRA INPUT TO APPLICATION (Cont'd)

- Define acceptance guidelines or criteria (e.g., acceptance guidelines of RG 1.174)
  - Results required
  - Method of comparison
- These activities result in an identification of
  - Scope of risk contributors
  - Level of detail required

CORE DAMAGE FREQUENCY ACCEPTANCE GUIDELINES



Acceptance Guidelines for Core Damage Frequency

ISSUES THAT IMPACT THE VALUE OF PRA INPUT

- "Quality" of PRA model
- Treatment of uncertainty
  - Parameter (e.g., component failure probability, initiating event frequency) uncertainty
  - Model uncertainty (e.g., success criteria)
  - Completeness (e.g., missing initiating events or modes of operation, errors of commission)

CHARACTERIZATION OF INPUT UNCERTAINTY

- Parameter uncertainty characterized by probability distributions representing state of knowledge about “true” value
- Model uncertainty may be represented as a discrete probability distribution over several models, with the probabilities representing the analysts’ relative degrees of belief in the validity of the models. More commonly, a single representative model is assumed
- By definition, incompleteness is not addressed in the model structure

APPROACH TO DEALING WITH UNCERTAINTY IN PRA RESULTS

- Objective is to provide assurance that the conclusion drawn from the PRA analysis is robust in light of the uncertainties
- Strategy
  - Identify and prioritize sources of uncertainty (with respect to their importance to the results being used)
  - Address parameter uncertainties by propagating uncertainties and using resulting mean value for comparison with acceptance guidelines
  - Address model uncertainties by developing an understanding of whether there are plausible, alternative assumptions that would impact the result of the comparison with the acceptance guidelines
  - Address incompleteness by one of the following approaches

APPROACHES TO ADDRESSING INCOMPLETENESS

- Provide qualitative arguments or bounding analyses
- Design the application so that it does not impact the unmodeled contribution to risk
- Make conservative decisions to compensate for missing contributions
- Perform a full scope PRA

“QUALITY” OF PRA

- NRC is less concerned with the quality of the PRA in its own right than with the quality of the decisions made (SECY-00-0162)
- The PSA must be capable of supporting the results used in the application in terms of scope, level of detail
- Different applications require use of different PRA elements: some, e.g., categorization of SSCs by risk significance, use the complete PRA; others, e.g., a simple tech spec change, require only a portion of the PRA
- Those elements of the PRA required for an application must be performed in a technically competent manner consistent with industry good practices

PRA QUALITY

- Defined in RG 1.174 and RG 1.200
  - For a given application, PRA Quality is determined by the appropriateness of
    - Scope (internal and external initiating events, full power and low power and shutdown operating modes)
    - Level of detail
    - Technical adequacy

TECHNICAL ADEQUACY OF PRA INPUT FOR A REGULATORY APPLICATION

- In the USA, the technical adequacy of licensee PRAs varies widely
- Some NRC Staff review of the underlying PRA will generally be required
- NRC and industry goal is to minimize and focus the review of underlying PRA
- PRA Standards and industry peer review process either have been or are being developed, and can be used to provide an understanding of the strengths and weaknesses of a PRA

STATUS AND SCOPE OF STANDARDS AND RELATED DOCUMENTS

- ASME: Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications (internal initiating events at full power) issued April, 2002, and Addendum A in December, 2003
- NEI-00-02: PRA Peer Review Process Guidance, supported by “sub-tier criteria” and guidance for self assessment against the ASME Standard, submitted for NRC review in December, 2001

STATUS AND SCOPE OF STANDARDS AND RELATED DOCUMENTS (Cont'd)

- ANS: Standard for PRA for external hazards for plants at full power (seismic, wind, other) issued December 2003
- ANS: Standard for PRA for low power and shutdown modes of operation, expected 2005
- ANS: Standard for PRA for internal fires, expected 2006

ASME PRA STANDARD FOR PRA FOR NPP APPLICATION

- Provides a Standard for performing and using a PRA
  - Definitions
  - Risk assessment application process
  - Risk assessment technical requirements
  - PRA configuration control
  - Peer review
- The Standard is a “what to do” but not a “how to do” Standard – it does not prescribe specific methods or standard assumptions
- One objective of the peer review is to assess the appropriateness of significant assumptions

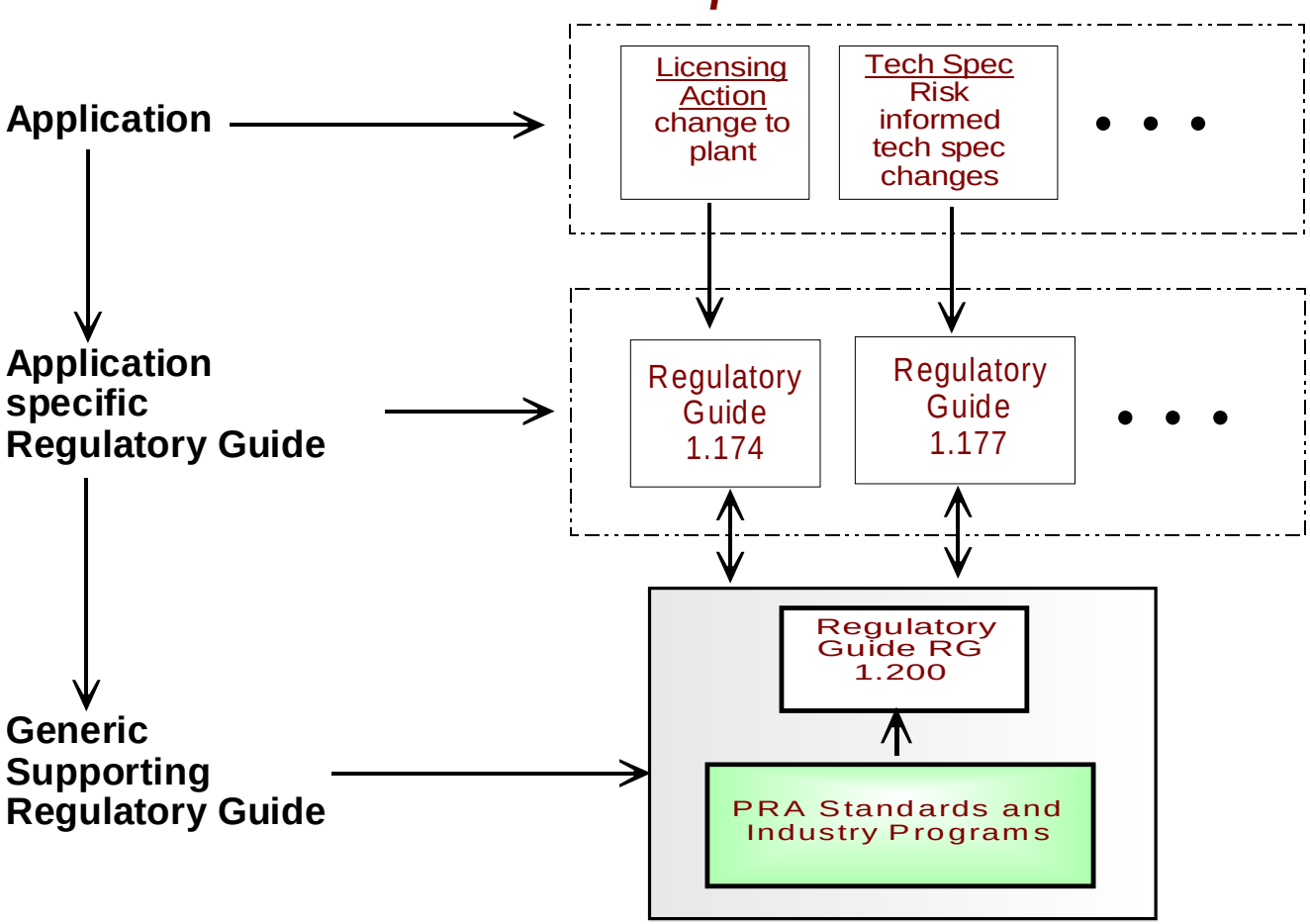
NRC STAFF GUIDANCE ON USE OF STANDARDS

- NRC in February 2004 issued RG 1.200 (and supporting SRP Chapter 19.1 that provides “An Approach for Determining the Technical Adequacy of PRA Results for Risk-Informed Activities” for trial use.

REGULATORY GUIDE/SRP

- Main body of RG provides general guidance to licensees on how to use a standard (or industry peer review program) to demonstrate and document that the PRA input to a decision is supported by a PRA of sufficient quality
- Appendixes to RG provide Staff regulatory position on the individual Standards or peer review process guidance (currently only the ASME Standard and NEI-00-02)
- Staff review will focus on those areas where alternatives to the Staff regulatory position are used

RELATIONSHIP OF RG TO OTHER REGULATORY DOCUMENTS



SRM ON PHASED APPROACH TO PRA QUALITY

- In December, 2003, the Commission issued an SRM entitled, Stabilizing the PRA Quality Expectations and Requirements
- Directs the staff to develop an action plan to:
  - Define a practical strategy for implementation of a phased approach to achieving PRA quality
  - Address the resolution of technical issues, such as:
    - Model uncertainty
    - Seismic and other external events
    - Human performance issues

APPROACH IN THE SRM

- Defines a phased approach to achieving an appropriate quality for licensee PRAs for NRC's risk-informed regulatory decision-making
- Allows continued practical use of risk insights while progressing towards more complete, and technically acceptable PRAs

THE PHASED APPROACH

- The phases are differentiated by the availability of guidance documents for using PRA in regulatory applications, and for establishing that the PRAs are of sufficient quality. These include:
  - industry consensus standards
  - industry guidance documents
  - regulatory guides and other guidance documents (e.g., NUREGs)
- Staff guidance documents addressing performance of reviews are required for implementation.

PHASE 1

- Phase 1 represents the status quo
- PRA quality judged only in the context of what is needed for the application - no requirement for the review of the base PRA
- All contributors to risk (operational modes and initiating event types) are considered
- Contributors to risk not in the scope of the PRA model are addressed in a number of ways including qualitative arguments, bounding analysis, and restricting the scope of application

PHASE 2

- An application type (“issue-specific”) approach to PRA quality
- PRA quality demonstrated by comparison with an applicable consensus standard for those elements required by the application
- All contributors to risk (operational modes and initiating event types, internal, seismic, fire, etc.) are addressed
- All significant risk contributors applicable to the issue are included in the PRA scope
- Significance of a contributor is determined by whether taking it into consideration could change the decision substantially

PHASE 2 (Cont'd)

- To achieve Phase 2, guidance must exist for
  - Use of PRA in making the decision (e.g., regulatory guides), including definition of scope
  - Assessment of the quality of the base PRA for each scope item used to support the application (e.g., Standards, RG 1.200)

PHASE 3

- Regulatory framework is in place that enables licensees to develop a base PRA to conform to all the existing Standards in sufficient depth to address all currently envisioned applications
- Phase 3 is scheduled to be completed by December 31, 2008
  - Consistent with schedule for Standards development
- A licensee enters Phase 3 when its base PRA conforms to all the existing Standards in sufficient depth to address all currently envisioned applications

STAFF REVIEW OF BASE PRA

- Phase 1: currently at the discretion of the reviewer but after trial use completed, will rely on peer review in accordance with RG 1.200 with audit for each application
- Phase 2: reliance on RG 1.200 for all significant contributors
- Phase 3: as for Phase 2 but performed one time sufficient to address all applications
- Phase 4: staff review and approval of base PRA

RESOLUTION OF TECHNICAL ISSUES

- Model uncertainty
  - Guidance document (e.g., NUREG) being developed that addresses the issue of treatment of uncertainties (e.g., model) in both the PRA and in decision making
- Seismic and other external events
  - ANS standard on external events under staff review (preliminary staff position for public review and comment issued August 2004)
  - Above document (on uncertainties) also includes guidance for acceptable alternative methods (e.g., bounding, sensitivity analyses) to a PRA
- Human performance issues
  - NUREG 1792 on good HRA practices to supplement the PRA (HRA) standard issued for public review and comment